What is claimed is:

1. A charged particle beam apparatus comprising:

a charged particle source;

a scan deflector for scanning a charged particle beam emitted from the charged particle source on a sample;

means for changing a focus of the charged particle beam emitted from said charged particle source;

a charged particle detector for detecting charged particles obtained at a portion of said sample irradiated with the charged particle beam; and

means for composing a two-dimensional image of the sample as seen from a direction of said charged particle beam source, based on signals at a portion on which said charged particle beam is focused, said signals being among signals output from the charged particle detector.

2. The charged particle beam apparatus as claimed in claim 1, wherein said charged particle beam apparatus stores signals output from said charged particle detector for each different focus; calculates characteristic quantities of arbitrary type which indicate in-focus degrees, using the stored signals; compares the characteristic quantities at same coordinates of signals each having a different focus; and forms said two-dimensional image based on the comparison.

3. The charged particle beam apparatus as claimed in claim 2, wherein said characteristic quantities are differential values or differential absolute values between pixels of an image based on said signals for each different focus, and said charged particle beam apparatus compares said differential values or said differential absolute values at same coordinates of images each for a different focus and uses a pixel value of an image having a large differential value or a large differential absolute value as a pixel value of said two-dimensional image.

4. The charged particle beam apparatus as claimed in claim 2, wherein said characteristic quantities are differential values or differential absolute values between pixels of an image based on said signals for each different focus, and said charged particle beam apparatus compares said differential values or said differential absolute values at same coordinates of images each for a different focus and composes a pixel value at a ratio of the differential values or the differential absolute values to form said two-dimensional image.

5. The charged particle beam apparatus as claimed in claim 2, wherein said characteristic quantities are differential values or differential absolute values between pixels of an image based on said signals for each different focus, and said charged particle beam apparatus compares

said differential values or said differential absolute values at same coordinates of images each for a different focus and composes a pixel value at a weighted ratio of the differential values or the differential absolute values to form said two-dimensional image.

6. The charged particle beam apparatus as claimed in claim 2, wherein said characteristic quantities are based on pixel values obtained by applying a Sobel filter to an image based on said signals for each different focus.

7. A charged particle beam apparatus comprising:

a charged particle source;

a scan deflector for scanning an charged particle beam emitted from the charged particle source on a sample;

means for changing a focus of the charged particle beam emitted from said charged particle source in a stepwise manner;

a charged particle detector for detecting charged particles obtained at a portion of said sample irradiated with the charged particle beam;

a storage medium for storing signals output from the charged particle detector for each focus; and

means for selectively reading signals of a portion in focus from the storage medium, and constructing a two-dimensional image extending in a direction perpendicular to an optical axis of said charged particle beam based on the

read signals.

8. A charged particle beam apparatus comprising:

a charged particle source;

a scan deflector for scanning a charged particle beam emitted from the charged particle source on a sample;

means for changing a focus of the charged particle beam emitted from said charged particle source in a stepwise manner;

a charged particle detector for detecting charged particles obtained at a portion of said sample irradiated with the charged particle beam;

a plurality of frame memories for storing signals from the charged particle detector for each focus changed in a stepwise manner; and

means for comparing signal values at same address of the plurality of frame memories, selecting a signal having a high focus evaluation value, and forming a sample image by putting the signal in each address.

9. A charged particle beam apparatus having means for adjusting a focus of a charged particle beam and constructing a sample image using irradiation of said charged particle beam, said charged particle beam apparatus comprising:

a storage medium for storing a sample image obtained for each adjusted focus;

reading means for selectively reading a specific area of the sample image stored in the storage medium; and

means for combining areas which are read by the reading means and which each has a different focus to construct a two-dimensional image extending in a direction perpendicular to an optical axis of said charged particle beam.

10. A charged particle beam apparatus comprising:

a charged particle source;

a scan deflector for scanning a charged particle beam emitted from the charged particle source on a sample;

means for changing a focus of the charged particle beam emitted from said charged particle source in a stepwise manner;

a charged particle detector for detecting charged particles obtained at a portion of said sample irradiated with the charged particle beam;

a storage medium for storing signals output from the charged particle detector for each focus; and

means for selectively reading signals of a portion in focus from the storage medium, and composing a two-dimensional image extending in a direction perpendicular to an optical axis of said charged particle beam based on the read signals, said composition being performed in parallel with said process in which the focus of the charged

particle beam is changed.

11. The charged particle beam apparatus as claimed in claim 10, further comprising a display means for displaying a process of said composition.

12. The charged particle beam apparatus as claimed in claim 11, further comprising means for externally stopping irradiation of said charged particle beam onto said sample.

13. A charged particle beam apparatus having means for adjusting a focus of a charged particle beam and constructing a sample image based on scanning of said charged particle beam on the sample, said charged particle beam apparatus comprising:

a storage medium for storing a sample image obtained for each adjusted focus;

selecting means for selecting a specific area of a sample image stored in the storage medium; and

means for replacing the sample image whose area has been selected by the selecting means, with a sample image having a different focus or another image.

14. A charged particle beam apparatus comprising:

a charged particle source;

a lens for converging and irradiating a charged particle beam emitted from the charged particle source onto a sample;

a detector for detecting secondary charged particles obtained at a portion irradiated with said charged particle beam;

a display device for displaying a sample image based on charged particles obtained by the detector;

means for storing position information in an irradiation direction of the charged particle beam for each specific position in the sample image displayed in the display device;

a specifying means for specifying an arbitrary position in a display screen of the display device; and

means for calculating a distance between two positions specified by said specifying means in said irradiation direction of the charged particle beam, based on position information about at least the two positions.

15. A charged particle beam apparatus comprising:

means for adjusting a focus of a charged particle beam;

means for constructing a sample image based on scanning of said charged particle beam on the sample;

means for measuring dimensions of an observation target on the sample based on the sample image;

a storage medium for storing a plurality of sample images obtained for each adjusted focus; and

image forming means for selecting a specific sample

image from said plurality of sample images, and forming a sample image using pixels indicating a focus evaluation value more than a predetermined value in the selected sample image;

wherein said charged particle beam apparatus performs said measuring of dimensions based on the sample image formed by the image forming means.

16. A chard particle beam apparatus comprising:

a charged particle source;

a scan deflector for scanning a charged particle beam emitted from the charged particle source on a sample;

means for changing a focus of the charged particle beam emitted from said charged particle source;

a plurality of charged particle detectors for detecting a plurality of different types of charged particles obtained at a portion of said sample irradiated with the charged particle beam; and

means for composing a two-dimensional image of the sample as seen from a direction of said charged particle beam source based on signals on which said charged particle beam is focused, said signals being among signals output from the charged particle detectors.

17. The charged particle beam apparatus as claimed in claim 16, wherein said charged particle beam apparatus stores signals output from said charged particle detectors

for each different focus; calculates characteristic quantities of arbitrary type which indicate in-focus degrees, using the stored signals; compares the characteristic quantities at same coordinates of signals each having a different focus; and forms said two-dimensional image based on the comparison.

18. The charged particle beam apparatus as claimed in claim 16, wherein said charged particle beam apparatus stores a plurality of different types of signals detected at the same time by said plurality of charged particle detectors for each different focus; calculates characteristic quantities of arbitrary type which indicate in-focus degrees, using one of the plurality of different types of stored signals; compares the characteristic quantities at same coordinates of signals each having a different focus; and forms said two-dimensional image composed of another type of detected signals based on the comparison.

19. The charged particle beam apparatus as claimed in claim 16, wherein when the characteristic quantity comparison does not produce a satisfactory result, said charged particle beam apparatus compares another type of detected signals to form said two-dimensional image based on the comparison.

20. A beam scanning inspection apparatus for forming

a sample image based on signals obtained by scanning a beam on the sample, said beam scanning inspection apparatus comprising:

focus changing means for changing a focus of said beam in a stepwise manner;

a storage medium for storing a sample image for each focus changed by the focus changing means; and

means for overlapping sample images stored in the storage means to form a sample image.

21. The beam scanning inspection apparatus as claimed in claim 20, wherein said beam is an electron beam.

22. A beam scanning inspection apparatus for forming a sample image based on signals obtained by scanning a beam on the sample, said beam scanning inspection apparatus comprising:

focus changing means for changing a focus of said beam in a stepwise manner;

a storage medium for storing a sample image for each focus changed by the focus changing means;

means for overlapping sample images stored in the storage means to form a sample image;

means for forming a line profile based on the overlapped sample image; and

means for measuring dimensions based on the line profile.

23. A method of composing a full-focused image, comprising the steps of:

reducing noise of a plurality of input images each read with a different focus;

evaluating noise amounts of the noise-reduced images whose noise has been reduced and evaluating in-focus degrees of said noise-reduced images to calculate signal change amount evaluation values;

generating a maximum signal change amount evaluation value and composition information based on the calculated signal change amount evaluation values;

generating favorableness degree information by determining a noise influence degree using said maximum signal change amount evaluation value and said noise amount evaluation values;

the series of steps being performed by a plurality of full-focused image composing means; and

generating a composite image based on a plurality of pieces of said favorableness degree information and a plurality of pieces of said composition information generated by said plurality of full-focused image composing means.

24. The method of composing a full-focused image as claimed in claim 23, further comprising a step of selecting composition information subjected to little noise influence

for each pixel from a plurality of pieces of composition information, using said plurality of pieces of favorableness degree information and said plurality of pieces of composition information, to compose a composite image from the selected composition information.

25. The method of composing a full-focused image as claimed in claim 23, further comprising a step of, before reducing the noise of said plurality of input images, positioning the plurality of input images and matching the intensity thereof.

26. The method of composing a full-focused image as claimed in claim 23, wherein at least one of said plurality of full-focused image composing means selects a predetermined default image included in said input images.

27. A full-focused image composing apparatus comprising:

a plurality of full-focused image composing means including:

noise reducing means for reducing noise of a plurality of input images each read with a different focus to generate noise-reduced images;

noise amount evaluating means for evaluating noise amounts of said noise-reduced images to calculate noise amount evaluation values;

signal change amount evaluating means for

calculating said noise amount evaluation values, and evaluating in-focus degrees of said noise-reduced images to calculate signal change amount evaluation values;

focus determination means for evaluating said signal change amount evaluation values to generate a maximum signal change amount evaluation value and composition information; and

noise determination means for determining a noise influence degree using said maximum signal change amount evaluation value and said noise amount evaluation values to generate favorableness degree information; and

composing means for generating a composite image based on a plurality of pieces of said favorableness degree information and a plurality of pieces of said composition information generated by said plurality of full-focused image composing means.

28. The full-focused image composing apparatus as claimed in claim 27, further comprising preprocessing means for, before said plurality of input images are input to said noise reducing means, either positioning said plurality of input images or matching the intensity thereof, or both.

29. The full-focused image composing apparatus as claimed in claim 27, wherein input images that have been previously input are subjected to a full-focused image

composing process by said full-focused image composing means in parallel with an input process in which said plurality of input images are input to said full-focused image composing means.

30. An electron beam apparatus for obtaining a scan image of a sample, comprising beam converging means for thinly converging a primary electron beam emitted from an electron source using an object lens, beam scanning means for scanning the primary electrons on a sample, detecting means for detecting secondary signals generated from the sample by scanning the beam on the sample, and image forming means for forming a sample image using the secondary signals, said apparatus comprising:

focus control amount determination means for determining an amount of change in a beam convergence position;

focus control means for controlling beam focal conditions according to the focus control amount;

image quantity determination means for determining the number of images;

image capturing means for capturing a plurality of images each under a different focal condition controlled by the focus control means; and

storage means for storing the plurality of images.

31. An electron beam apparatus for obtaining a scan

image of a sample, comprising beam converging means for thinly converging a primary electron beam emitted from an electron source using an object lens, beam scanning means for scanning the primary electrons on a sample, detecting means for detecting secondary signals generated from the sample by scanning the beam on the sample, and image forming means for forming a sample image using the secondary signals, said apparatus comprising:

focus control amount determination means for determining a beam convergence position change amount;

focus control means for controlling beam focal conditions according to the focus control amount;

image quantity determination means for determining the number of images;

image capturing means for capturing a plurality of images each under a different focal condition controlled by the focus control means;

storage means for storing the plurality of images; and

image constructing means for constructing an image using the plurality of stored images.

32. The electron beam apparatus as claimed in claim 30, wherein said focus control amount determination means determines a focus control amount by using one or a combination of two or more of an acceleration voltage

(Vacc), a working distance of an object lens (WD), a beam convergent angle (α), an image magnification (M), an image resolution (R) decided by a primary beam diameter, the number of pixels of an image (Npix), a pixel size of an image (dpix), and a probe current (Ip).

33. The electron beam apparatus as claimed in claim 32, wherein when A1 and A2 denote coefficients, said focus control amount is determined by the following relationship:
when the observation magnification (M) is smaller than a predetermined value,
focus control amount = A1 × dpix/M, and
when the observation magnification is larger than a predetermined magnification,
focus control amount = A2 (constant)

34. The electron beam apparatus as claimed in claim 33, wherein the value of said coefficient A1 is determined by the relationship that the coefficient A1 is inversely proportional to the beam convergent angle α.

35. The electron beam apparatus as claimed in claim 33, wherein the value of said coefficient A1 is determined by the relationship that the coefficient A1 is proportional to the product between the square root of the acceleration voltage (Vacc) and the primary electron beam resolution (R) under the current beam conditions.

36. The electron beam apparatus as claimed in claim

33, wherein the value of said coefficient A2 is determined by the relationship that the coefficient A2 is proportional to the product between the square root of the acceleration voltage (Vacc) and the square of the resolution.

37. The electron beam apparatus as claimed in claim 34, wherein either one or both of said coefficient A1 and said coefficient A2 are determined by a proportional relationship to the value of a function determined by an electron beam intensity (Bs) and the probe current (Ip).

38. The electron beam apparatus as claimed in claim 30, wherein a value of said focus control amount is selected from table values predetermined for each acceleration voltage.

39. The electron beam apparatus as claimed in claim 30, wherein said image quantity determination means specifies the number of images to be sequentially captured by directly entering a numerical value or selecting a numerical value from a list.

40. The electron beam apparatus as claimed in claim 39, wherein said image quantity determination means limits the maximum number of images to be set according to the number of pixels of the images.

41. The electron beam apparatus as claimed in claim 30, wherein said image quantity determination means comprises:

focal range setting means for setting the upper limit and the lower limit of a focal range; and

image quantity calculating means for calculating the number of images using values set by the focal range setting means.

42. The electron beam apparatus as claimed in claim 41, wherein said image quantity determination means comprises:

focus adjustment value registering means for registering each of two focus adjustment values; and

image quantity calculating means for calculating the number of images using values registered with the focus adjustment value registering means.

43. The electron beam apparatus as claimed in claim 30, wherein said image quantity determination means comprises:

focal depth setting means for setting a difference between focus control ranges (focal depth); and

calculating means for calculating the number of images based on a value set by the focal depth setting means.

44. The electron beam apparatus as claimed in claim 30, wherein said focus control means sequentially captures a series of a predetermined number of images while controlling a focus in an under-focus direction using a

current focal state as a reference.

45. The electron beam apparatus as claimed in claim 30, wherein said focus control means sequentially captures a series of a predetermined number of images while controlling a focus in an over-focus direction using a current focal state as a reference.

46. The electron beam apparatus as claimed in claim 30, wherein said focus control means sequentially captures a series of a predetermined number of images while controlling a focus within an over-focus range starting from an over-focus state, using a current focal state as a center state.

47. The electron beam apparatus as claimed in claim 31, wherein said image constructing means for constructing a new image using a plurality of images, performs a series of steps, said series of steps comprising:

a position correcting step of correcting a positional displacement between images;

an intensity correcting step of correcting a difference in intensity between images;

an in-focus image extracting step of extracting an image element most closely in focus, from among image elements corresponding to one another between images; and

a full-focused image constructing step of constructing a new image by combining the extracted image

elements.

48. The electron beam apparatus as claimed in claim 30, further comprising display means for indicating a focal depth value of an image composed using a plurality of sequentially captured images.

49. The electron beam apparatus as claimed in claim 31, further comprising:

specifying means for specifying two arbitrary points in an image composed using a plurality of sequentially captured images;

calculating means for calculating a height difference between the two points specified by the specifying means; and

displaying means for displaying the calculation results from the calculating means.